**Chemistry Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Intro to Stoichiometry: Mole ratios Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Block \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Write the balanced equation for the reaction between hydrochloric acid and sodium bicarbonate (baking soda). Use appropriate symbols to identify the physical state of each of the substances.

The coefficients in a balanced equation are the mole ratios for the substances in the reaction.

Purpose: To determine the mole ratio of sodium bicarbonate to sodium chloride based on the balanced equation.

Procedure:

1) Mass a clean, dry test tube

2) Add 1.0 g of sodium bicarbonate to the test tube and mass

3) Add 6M HCl drop-wise until all the sodium bicarbonate is reacted

4) Gently boil the water out of the test tube

5) Mass the test tube and sodium chloride (heat to constant mass).

6) Fill in the data table below and find the experimental mole ratio of sodium bicarbonate to sodium chloride.

Data Table

|  |  |
| --- | --- |
| Mass of test tube |  |
| Mass of test tube and NaHCO3 |  |
| Mass of NaHCO3 |  |
| Moles of NaHCO3 |  |
| Mass of test tube and NaCl |  |
| Mass of NaCl |  |
| Moles of NaCl |  |
| Moles NaHCO3/Moles NaCl |  |

Mole conversion calculations:

Compare the actual mole ratio and the experimental mole ratio. What are possible sources of error?

**Questions/Calculations: Show all calculations.**

1. Write the balanced equation for this reaction.

2. There are actually two types of reactions occurring here – identify them.

3. Referring to the coefficients in this equation:

* What is the ratio of moles of NaHCO3 reacted to moles of NaCl produced?
* What is the ratio of moles of NaHCO3 reacted to moles of H2O produced?
* What is the ratio of moles of NaHCO3 reacted to moles of CO2 produced?

4. What mass of NaHCO3 did you use in this reaction? Convert this mass to moles.

5. Based on the actual number of moles used and the coefficients in the balanced equation, how many moles of NaCl would you expect to produce? Convert this number of moles of NaCl to mass in grams. This predicted value is known as the theoretical yield.

6. Based on the expected ratio, how many moles of H2O would you expect to produce? Convert this number of moles to number of molecules of H2O.

7. How many moles of CO2 gas would be expected? Convert this value to STP volume.

8. The hydrochloric acid you used was an aqueous solution of the compound hydrogen chloride. In its pure form, hydrogen chloride is a gas. Only the molecules of HCl participated in the reaction. The water provided the environment in which the HCl was able to react. How many moles of HCl were consumed by the NaHCO3 as it reacted?

9. What procedural step was used to guarantee that enough moles of HCl were provided by the acid to react *all* of the NaHCO3?

What happened to the *excess* HCl?

(Because there was more than enough HCl used in this reaction, it is called the “excess reagent”.)

10. What mass of NaCl was actually produced? This value is known as the actual yield.

11. We often express yields (amounts of product formed) in terms of percentage. The *percent yield* is a calculation reflection how much of the theoretical amount was actually produced:

Actual yield (g) x 100% (100% yield would be a perfect outcome)

Theoretical yield (g)

Calculate the percent yield of your NaCl.

Compare/contrast this calculation to the *percent error* process.

12. If you had started with 7.5 grams of NaHCO3 and sufficient HCl for a complete reaction, what mass of NaCl would you expect to produce?

13. If you wanted to produce exactly 1.75 grams of NaCl, what mass of NaHCO3 would you start with (assuming a “perfect” procedure)?